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BULLETIN

OF THE SOCIETY OF ARTS

MARCH, 1910

**669th Meeting
March 11th**

Professor Percival Lowell, non-President Professor of Astronomy at the Institute of Technology and Director of the Lowell Observatory at Flagstaff, Arizona, on "Comets," Huntington Hall, Friday evening, March 11th, at 8 o'clock. It is a delight to listen to Professor Lowell on any subject, and his discussion of the general phenomena of comets, in particular of Halley's Comet, which will be in close proximity to the earth May 18th, is an opportunity members of the Society will appreciate.

**670th Meeting
March 30th**

Mr. Elmer A. Sperry, of New York City, on "The Gyroscope and its Practical Application in Steadying Ships, Monorail Locomotion, Aërial Flight, and as a Mariner's Compass," Huntington Hall, Wednesday evening, March 30th, at 8 o'clock. Mr. Sperry will illustrate his lecture with operating apparatus and lantern slides. The uses of the gyrostat in monorail cars, steamships, and in directing torpedoes will be illustrated by working models, and the principle of the gyroscope will be fully explained. The fundamental element of precession will be developed and illustrated experimentally. As an engineer, Mr. Sperry has made special research along the lines of gyroscopic reactions. He spent four months abroad last year investigating this subject.

At the 667th meeting of the Society of Arts, held in Huntington Hall, February 9th, the following applicants for membership were elected:—

Charles H. Traiser, 530 Beacon Street, Boston.
George Newcomb, 15 Ward Street, Salem, Mass.

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THE SOCIETY OF ARTS OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The Society of Arts was established as a department of the Institute by President Rogers in 1861.

It is especially devoted to the general dissemination of scientific knowledge, and it aims to awaken and maintain an interest in the recent advances and practical applications of the sciences.

Any person interested in the aims of the Society is eligible to membership.

The annual dues are $3.

EXECUTIVE COMMITTEE

RICHARD C. MACLAURIN, President of the Institute.

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W. S. LELAND
I. W. LITCHFIELD

I. W. LITCHFIELD, Secretary, Massachusetts Institute of Technology, Boston.

PROFESSOR LOWELL ON "COMETS."

In about two months the earth will pass through the tail of Halley's Comet, and because of the great public interest in this event the announcement that Professor Lowell will address the Society of Arts on "Comets" will be welcome.

Those who heard the speaker a year ago, when he addressed the Society at the centennial anniversary of the birth of Charles Darwin, have not forgotten his memorable effort on that occasion. In this connection we cannot refrain from quoting a portion of an editorial on this address in the Boston *Herald* for the benefit of those of Dr. Lowell's hearers who may not have seen it:—

"To precision and economy of words, Professor Lowell also brought wit, satire, lightness of touch, a literary quality that charmed, and a polemical spirit that recalled Huxley, who used to confute with derision when reason would have been beyond an opponent's understanding. A philosopher emerged, not only competent to speculate on cosmic modes of life and on the reason for society's conservatism, its almost inevitable attitude of opposition toward, and punishment of, its discoveries of truth, but large enough to point out that, ever in the pangs and sorrows which the isolated, misunderstood and unappreciated pioneer undergoes, he finds a discipline of soul that makes him greater than otherwise he could have been. For blending of latest fact and speculation as to cosmical doings based on physical research, with shrewd comment on the virtues and defects of human nature, Professor Lowell's talk was singularly fine. Moreover, it inevitably suggested to the listener certain applications of the truths set forth respecting the lot of the pioneer to the speaker's own case. There is nothing in science or in the demands it makes for truth-telling to prevent a popular exposition of it, whether written or spoken, from being quite as interesting as fiction or oratory or poetry, providing the exposition is well done."

PRACTICAL USES OF THE GYROSCOPIC PRINCIPLE.

The application of gyrostatics to means of transportation by land, sea, and air, although but newly developed, has attracted much attention because of its speculative value to mankind.

The successful application of this principle to practical uses by Dr. Schlick and Mr. Brennen has apparently brought the device into the realm of commerce.

The Society is fortunate in securing Mr. Elmer A. Sperry to address the Society on this subject on the evening of March 30th. After obtaining his engineering education at Cornell, Mr. Sperry entered the field of electrical engineering, and has since been identified with a large number of important enterprises. He was one of the founders of the American Institute of Electrical Engineers, and is also a member of the Society of Naval Architects and Marine Engineers and the American Electro-Chemical Society.

For many years Mr. Sperry has made special study of the gyroscope, and during a considerable period spent abroad last year he had practical experience with monorail cars and with ships equipped with gyrostatic steadying plants.

Besides an interesting collection of lantern slides, the lecturer has several pieces of operating apparatus, among them a model of the monorail car large enough for actual demonstration with a passenger.

THE CHEMISTRY OF MODERN ILLUMINANTS.

On Wednesday, February 23, Professor Henry P. Talbot, in charge of the department of chemistry and chemical engineering at the Massachusetts Institute of Technology, addressed the Society in Room 6, Lowell Building, Clarendon Street, on the "Chemistry of Modern Illuminants." Beginning with the candle and leading through the oils to the gases and incandescent gas lighting, Dr. Talbot entertained his hearers for nearly two hours with a series of experiments graphically explained with little or no reference to professional nomenclature.

Professor Talbot said that the candle is one of the older forms of lighting, but comes down to us to-day practically the lineal descendant of the rush light, made by dipping rushes in tallow. To-day we ask for something better than this, for what has been used fifteen or even ten years ago is too old-styled to keep up with the advance in lighting. Three things are demanded of the candle to-day: it must not smoke, it must be hard enough to stand by itself, and yet soft enough to melt and furnish a steady light. Candles are now made from tallow, waxes, paraffine, mineral waxes, and fat acids, notably stearic. The best grade of candles is made from stearic acid, and the second best from a combination of paraffine and stearic acid. Dipping of candles has gone out of practice except in exceptional cases. A method of pouring molten paraffine over the wick is sometimes employed, but requires much skill, and the candles have to be rolled into shape by hand after they are finished. Pouring into moulds is the usual method of manufacture.

The process of preparing the candle in its first step resembles that which our grandparents employed in the making of soft soap. A glyceride is mixed with lime, producing a lime-soap, with a by-product of glycerine which is a valuable part of the process. The lime-soap is treated with sulphuric acid, giving the fat acids and calcium sulphate as a by-product. These fat acids are known as palmitic, stearic, and oelic acids, the latter being oily, and the former solid. The oelic acid is filtered out, and the stearic and palmitic separated by alternate heating and chilling. Another method of obtaining the fat acid is by treating the glyceride with steam instead of lime. In burning, the candle acts as a little gas machine, drawing the solid part up into the wick in a molten condition where the heat changes it into a gas, which in turn gives the burning flame its illumination in the same manner that the ordinary illuminating gas does. Carbon dioxide and water are products of the combustion. The carbon dioxide does not affect the body as a poison, but, if it accumulates, it shuts out the supply of oxygen from the lungs, promoting partial and finally complete suffocation.

Regarding the oils as illuminants, Professor Talbot said that sperm oil can hardly be classed as a modern illuminant. Oils extracted from petroleums are obtained by fractional distillation. After the crude oil is led from the wells, hundreds of miles perhaps, to the refinery, it is heated and the lighter oils are first driven off and collected. The gasolenes, kerosenes, lubricating oils, and the very heavy oils, such as paraffine, volatilize in the order given. If kerosene oil should be sent out in a raw state, the lamp wicks would soon gum and the lamps become smoky. Following the distillation, sulphuric acid is added to the kerosene, forming an acid sludge which settles out, carrying with it the heavier impurities. The oil is then washed with caustic soda to remove the acid, and then with water to remove the soda in its turn.

After standing, the oil is next treated with fuller's earth to remove the color. To purge the oil further of the light oils, the kerosene is sometimes sprayed through the air, where the lighter materials evaporate. The laws regarding the sale of oil are very strict in Massachusetts, oil which gives a gas inflammable below 110 degrees Fahrenheit being forbidden.

Regarding the gases, Professor Talbot said that the Pintsch gas, used largely in passenger trains, was made from crude petroleum by the "cracking" process, most of the gas volatilized by this process remaining permanently volatile. Household gas is made largely from distilling coal, which is put into a retort and heated, undergoing decomposition. The tar obtained at the same time yields various by-products. The gas is passed through scrubbers or a water tower, to extract the ammonia. Sulphur is also extracted, for its presence in the form of sulphur dioxide would bleach wall papers and everything in the house, while hydrogen sulphide is one of the most poisonous gases which can be inhaled, acting directly on the blood. The Massachusetts law forbids more than twenty grains of sulphur per hundred cubic feet of gas. A few minutes' immersion of a red carnation in a glass jar of sulphur dioxide gas was sufficient to bleach it out to nearly pure white.

Water gas is formed by treating carbon with steam, producing carbon monoxide and hydrogen, which burn with a colorless flame. The addition of some of the lighter oils to this gas is necessary for its utility as an illuminant. The luminosity of the burning gas flame is caused by the decomposition of a portion of the gas by the burning of the rest, which gives very finely divided particles of carbon which are tossed about in the flame, their white-hot condition producing the light.

Professor Talbot said that acetylene is alleged to give off less heat per unit of light and cost less for the amount of light produced than any other illuminating substance. Its explosive qualities are far greater than those of the other gases when mixed with air. Dr. Talbot showed, experimentally, the principle of the acetylene torch, which bursts into flame on coming in contact with water and is used in rescues at sea.

Acetylene is so rich in carbon that it requires special burners, and these are usually double-forked, so that the gas, on rushing out, pulls the air with it, furnishing the additional oxygen necessary for the combustion and also causing combustion to take place at a little distance from the burner, thus avoiding certain difficulties due to overheating of the acetylene before its combustion. When the light is burned low, not enough oxygen is brought into contact with the carbon, and as a result a deposition of carbon on the burners often clogs the light.

The following table shows the explosive limits of gases with air, as follows:—

Gas	*Lower Limit*	*Upper Limit*
Carbon monoxide	16.50%	74.95%
Hydrogen	9.45%	66.40%
Water gas	12.40%	66.75%
Acetylene (uncarborated)	3.35%	52.30%
Coal gas	7.90%	19.10%

Acetylene may explode from its own decomposition. Heat increases the velocity of this acetylene reaction, and, if it is started on the road to decomposition, it will go to pieces itself. If it is compressed under a thirty pounds' pressure or heated to 780 degrees Centigrade, it decomposes with violence. Yet it is carried under 225 pounds' pressure without danger, because it is dissolved in acetone, in the steel cylinders which are coated with copper on the outside. These are completely filled with asbestos, to which is added acetone, and then acetylene under 275 pounds' pressure. On chilling, the gas pressure is lessened and more gas is added until the final result is a 225-pound pressure tank at ordinary temperatures.

Dr. Talbot closed his talk with a discussion of incandescent light mantles, exhibiting a series of slides of the Welsbach factory where these mantles are made. The peculiar incandescence depends on the rare earths cerium and thorium. The mantles are first made from cotton or a Chinese ramie fibre, which is treated with great care as regards its purity. The purity of the woven tubes is necessary in order to get a pure ash. After the tubes are washed and drawn up on one end with an asbestos cord, they are immersed in baths of cerium and thorium salts. The mantles are then passed through the "equalizer," which gives the fabric an even content of the salts. The cotton or ramie fibre is then burnt out, leaving but a thin shell of cerium and thorium oxides. They are then formed and hardened in a blast lamp.

Exceedingly fragile in this condition, the mantles cannot withstand the lightest jar, and hence are unfit for transportation. To overcome this, they are immersed in collodion, a substance made up of cellulose nitrate and ether, which hardens in the air, and is what the consumer burns off after attaching the mantle to the gas burner.

Experimentation with incandescent mantles began with calcium, but this element was found of little effect, and the rare earths were turned to, which are found largely in Brazil and North Carolina. The best results are obtained with one to one and a quarter per cent. of cerium oxide with the rest thorium oxide, the cerium acting as an excitant for the other element. The cerium gives the light its yellowness which makes for luminosity, the pure thorium light being white.

The relative effectiveness of the light in comparison with the percentage of cerium oxide is: pure thorium, 7 candle power; ¼% cerium, 56; ½% cerium, 77; ¾% cerium, 85; 1% cerium, 88; 1½% cerium, 79; 2% cerium, 75; 3% cerium, 65; 5% cerium, 44; 10% cerium, 20.

DR. WILEY TELLS OF OUR DEBT TO CHEMISTRY.

On Wednesday evening, February 9th, Dr. Harvey W. Wiley, of Washington, chief chemist of the United States Department of Agriculture, addressed the Society in Huntington Hall on the "Services of Chemistry in the Promotion of the Public Welfare." Declaring that one of the greatest natural resources a country can have is the health of its people, Dr. Wiley showed how chemistry and her kindred sciences had defended this resource in prevention of disease and conservation of the body, expressing his opinion that in the future the ideals of honesty embodied in the pure food laws would permeate every phase of society.

After reviewing the services of chemistry in the purification of our supplies of water and milk, Dr. Wiley said:—

Chemistry is rendering a most signal service to humanity in seeing that the drugs of the country are pure. Now I will not discuss the efficacy of drugs. I realize that there is a great difference of opinion in regard to this matter, just as there is in regard to the utility of vaccination. There will never come a time when all people will agree upon everything. We shall never care to come to that. The earth would be uninhabitable if we had such a humanity as that. It is disharmony that makes harmony beautiful. So, while people will never agree about the efficacy of drugs, we will assume, for the sake of the argument, that drugs do have virtue. Do you know what condition the drugs of this country were in even five years ago? Why, they were adulterated through and through. The other night a man told a story that I am going to take the liberty to repeat. Four flies went upon an excursion. The first thing they saw was a dish of fly poison. They said, "We will fight shy of that." So they headed for the sugar-bowl. One fly took some of the sugar, and he died of poisoning from sugar of lead. So the other fly said, "I will eat of the molasses," and that had red dye in it, and that fly also died. Then the third fly sought the flour, and that was mixed with plaster of paris, and he died of a plaster cast. The fourth fly looked around upon his dead comrades, and he said: "All my comrades are gone. I might as well die. I shall commit suicide." So he nibbled the fly paper, and he lived, because the fly poison was adulterated and perfectly harmless.

Now, if a drug has any virtue, it is because it possesses what it is supposed to possess. Through the efforts of the chemist the drugs are now pure. They are inspected before they pass from one state into another. Five years ago, if you had gone into a store to get cream of tartar, you wouldn't have procured it. You would have got some substitute for it. That only illustrates to what an extent the drug supply of this country was adulterated. A great service has been rendered to the public in the purification of the drug supply. A means has been provided whereby adulteration may be properly combated.

Then, again, chemistry has done a service to the public in recent years in securing an increased purity of our food supply. I do not know any better way to conserve the public health than to give to the public pure and nutritious food. The man that is underfed, the man that is fed imperfect food, has his powers of resistance to disease diminished just by that much. The physician will tell you that man has within his own blood organisms which are capable of seizing upon and destroying other organisms. Perhaps every man and woman here has been infected with the germ of pneumonia or tuberculosis. But your blood has been so well supplied with those germs to which I have referred that your health has been conserved.

Now whence come these bodies that protect us? The generous food supply that you have, of course. You diminish your food supply, and you diminish the number of these organisms that can destroy the intruding infection germs. An epidemic flourishes among the poorly fed and dirty, not so much because they are dirty as because they are nonresistant to the action of these germs. In dirt alone there is not so much danger, but, if you are starved and dirty, too, you are subject to infection. If you are well fed, you are comparatively safe. Imperfect or impure food makes you nonresistant to disease germs.

What will the public do to protect itself? It will see that, as far as possible, all parts of the community are well fed. The public-spirited people of this country are taking steps to see that the poorly nourished children who go out to our public schools shall have something to eat before they begin to learn decimal fractions. It is more important to the children to have a square meal than it is to know how to extract the square root or the cube root of anything. You cannot cultivate the intellect when the stomach is starving. If you want to convert a man, feed him first: don't attack him when he is hungry. Good nourishment and plenty of it is necessary both for good health and good temper. Now the chemist says that, when a man asks for bread, he should get bread and not chaff, and, when he asks for breakfast food, he should get cereal and not sawdust. The chemist distinguishes between the false and the true with unerring certainty, so that what appears all right to the eye is revealed in all its nakedness by the chemist. Professor Prescott, of the University of Michigan, said, when we were discussing this subject of harmful and harmless adulterations: "No, there are no harmless adulterations. Every adulteration of food threatens health." And it is true. If you put water into milk, you render it an unbalanced ration, and it threatens health. I believe that any tampering with food will render it less nutritious, less digestible.

We have heard a great deal of discussion of late about high prices, and people are forming leagues, promising each other they will eat no meat. That is a curious kind of a promise to make. I would never make any such promise myself. I cannot for the life of me see why I should cease to eat meat, liking it as well as I do, so that somebody else that likes it better can get it cheaper. I am going to continue to eat meat as long as I have got the "price."

As to the question whether meat is necessary to preserve health, I want to say that it appears to me that man is a carnivorous animal. He eats everything he can get his teeth into. I would hesitate to prophesy what disastrous results might come to the human race, should it give up the use of meat. I know that there are people who live solely on vegetables. I have seen them and looked into their wishing eyes, and felt like taking them down to the restaurant and giving them a good beefsteak. I know, too, that men enjoy reasonable health on a raw diet or a diet of fruits; that other men eat exclusively meats, and apparently are well. But the number of people who eat the mixed diet is so infinitely greater than the number of those who eat a restricted diet, there is no data upon which to frame an assumption of freedom from injury through restriction. Man has eaten meat from the early periods of evolution. He will continue to eat meat as long as the world stands. If man were to eat nothing but vegetables for centuries, he would become a different kind of an animal. The animals that eat no meat have two or three stomachs. Now, when you think how much it costs to feed one stomach, are you going deliberately to run the risk of developing a second or a third stomach? All fads have their use. I don't denounce any of them. Every single vagary of the human intellect is of some good. The man who preaches vegetarianism does a service to humanity because so many people eat too much meat, much more than they ought to eat. They might diminish their meat supply to their own great benefit. The man who says you must eat nothing but nuts and fruits, the man who says you must eat only uncooked foods, these have both done good to the science of dietetics. We can take good from all these theories. But the chemist knows that a rational diet is comprised of so much protein, so much of this, and so much of something else. And so I say that the service of chemistry in controlling the food supply, in showing what the normal ration is, in demonstrating the chemical changes that go on during digestion,—all of this is inestimable. Physical man is an engine of high efficiency, utilizing, far more than any machine that man has ever built, the energy of his food. Just think how much work a man can do on four pounds of food a day, and think how little an engine can do on four pounds of coal a day. The absolute, the perfect efficiency of the human machine and the efficiency of the machine that man makes are contrasted. Yet both are governed by the same laws. So chemistry has put the science of dietetics on an absolute, scientific basis. Every step can be followed from the beginning to the end, and in my opinion one of the greatest services which chemistry has rendered to the people of the world is in that absolute control of the vital functions of life,—not only in man, but in the plant as well. It is the function of chemistry to teach our farmers how to bring back farms to a state of fertility. It is chemistry that is going to provide for the people that are going to live upon this earth three hundred years from now. Chemistry will show how to produce the food for that vast host of citizens. We would despair of the public health and public progress if the services which chemistry has rendered, and which it is going to render, should be withdrawn. There would be no hope for the prosperity of our people.

There are other services which chemistry has rendered of a less material nature. It has done more than any other science to build up in this country reverence for morality in trade. It has taught the people of this country to love the truth. There has grown up in this country and every country a habit of misrepresentation, which has been practised so much and so long that the people don't know they practise it. If I tell a reputable business man that he has stolen money, he will sue me for libel. Yet there is hardly a business man in this city that has not been stealing money since he entered into business. But chemistry is teaching him to restrain this tendency as far as foods and drinks are concerned. We don't misrepresent as we did a few years ago. Chemistry has built up the whole moral tone, and chemistry only represents science in general, because science is nothing but absolute devotion to the truth. A year ago last fall I addressed a meeting of those people who write advertisements. Have you ever read advertisements and compared them with the facts they are meant to represent? If you have, you will learn that in a large majority of cases they do not represent the facts at all. I called the attention of a prominent physician present to an advertisement he was responsible for. I said, "There isn't a word of truth in it." He came to me afterwards and owned up to the fact, and he added that it would never get out again.

I say that chemistry has done its share with other sciences in promoting the public welfare, and there is much more yet that chemistry will do. The time will come yet when you can go to a jewelry store and buy a piece of silver and know that it is not washed, when a young man can buy a diamond for his sweetheart and know that it is not paste, when you can go into a store and buy silk and know that it is silk, not cotton. This thing is bound to extend to every branch of trade. Already in the Congress of the United States a bill has been introduced called the "Merchandise Marks Act." When it has been once passed, it will be a felony to send any kind of merchandise under a misconception, from one state to another. It will be a long time before it becomes a law, but it is bound to come because it is right, because these eternal principles of truth appeal to the average American citizen. I would surely despair of the public if I thought that 95 out of a hundred were dishonest. I know that 95 men out of a hundred are honest, want to do what is right. They didn't realize what they were doing: they had never thought about it particularly. It was the common habit of trade, just as is the mark-down from $5.00 to 50 cents, when the thing was never worth more than 45 cents.

I just want to make a suggestion to the committee in charge of the postal deficit. I want to make the suggestion that all newspapers and magazines be allowed to go at the present rate of postage, provided they carry no false or misleading advertisements about anything, and the very moment that they carry a false or misleading advertisement they shall be obliged to go at letter rates. That will fill up the coffers of the government and avoid deficit, should they continue with the present advertisements. Why should the government of the United States pay the postage on material which is intended to corrupt the morality of the American public? For no reason that I can see. I can see every reason for sending that kind of literature at the highest possible rates, for it carries misleading advertisements that will certainly deceive somebody. I refer to the advertisements of those so-called patent medicines. The greatest curse that ever descended upon any country is that which rests upon this country in this respect. The idea that you can cure tuberculosis and appendicitis, or any other disorder like them, by nostrums of this kind! And yet the newspapers and magazines of this country are carrying just such advertisements. I want you good people to join with me in this propaganda which I have been preaching, and let us take the science of chemistry, botany, bacteriology, and the truth of the gospel,—all of these together,—to free our country from all that is false, and place it in the forefront of progress and morality, as it is already in the forefront of material progress.